

SCIENCE

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A SLOW-SPEED ELECTRIC MOTOR.

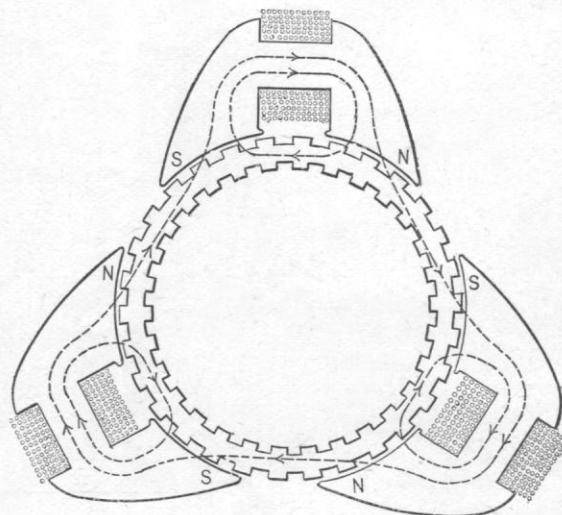
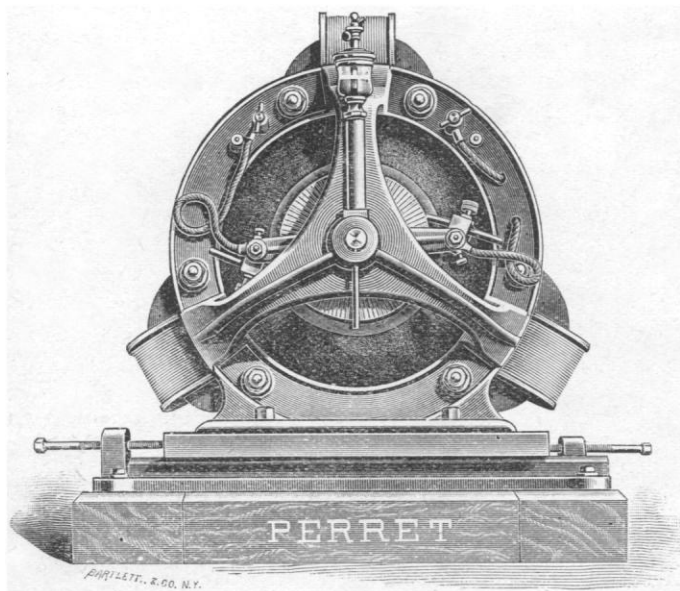
A NEW automatic low-speed electric motor, designed by Frank A. Perret, electrician of the Elektron Manufacturing Company of Brooklyn, is shown in the accompanying illustrations, Fig. 1 being an end view, and Fig. 2 a section showing the magnetic circuit. It is of the multipolar type, and is designed to run at from 500 to 600 revolutions per minute. For special work the armature may be wound for a speed of 850 revolutions. While the speed is comparatively low, the machine is not heavy, as is the case of many motors designed for slow speed for special work.

The practical advantages of low-speed motors are many. In ordinary machine-shops, wood-working shops, and printing-offices, for example, the shafting is commonly run at from 200 to 300

heavy load is thrown suddenly on, as is often the case in elevator-work and hoisting.

These larger motors retain the distinctive feature of laminated field-magnets which were characteristic of the smaller Perret machines, as, it is claimed, the results secured would be practically impossible with any other construction. The armature is a ring of comparatively large diameter, with longitudinal channels on its periphery, in which the conductors are wound. They are thus embedded in the iron, which is in such close proximity to the iron pole-pieces that there is practically no gap in the magnetic circuit.

The field consists of three separate magnets, arranged at equal distances around the armature, each magnet having two pole-pieces, the winding being such as to produce alternate north and



FIGS. 1 AND 2. — PERRET MULTIPOLAR ELECTRIC MOTOR.

revolutions per minute; and it is a simple matter to belt directly to it from a motor running at 500 or 600 revolutions, thus dispensing with extra shafting and belting. These motors have recently been applied by direct gearing to pumps and to coal-cutting machines in mines, and also to the operation of coal-cutting machines by means of rope transmission from the motor to the cutter. Their slow speed also makes them well fitted for the direct driving of large exhaust fans and blowers, and for operating hoists and travelling cranes. In addition to the advantages of low speed in the special cases mentioned, there is, of course, a general advantage in the avoidance of the rapid wear and deterioration often connected with high speed.

These motors are built with a 6-pole field, and with armatures of large diameter. A powerful torque and great momentum of armature are secured, which are decided advantages when a

south poles. The magnets are built up of plates of soft charcoal iron, which are shaped as shown in the diagram, the magnet thus produced being readily wound in a lathe. A non-magnetic bolt passes through a hole in each pole-piece, and the plates are clamped together between washers and nuts. The bolts also serve to attach the magnets to the two iron end frames, which are of ring-shape, and are bolted to the bed-plates of the machine. The magnetic circuit is of unusually low resistance, by reason of its shape, its shortness, which is shown by the diagram, and the superior quality of iron used.

There is, it is claimed, no loss of magnetism in the frame or in the shaft of the machine, as the magnets are supported at some distance from the former by means of the non-magnetic bolts, and the armature is mounted on the shaft by spiders of non-magnetic metal. The whole machine is enclosed by a shield or case of sheet

metal, as shown in Fig. 3, which is a perspective view of a motor, with sliding base and starting-box complete.

These machines are calculated to be equally efficient as dynamos, and are coming into use in many small isolated incandescent-light plants. For this purpose they are compound wound; and the regulation, it is claimed, is so perfect, that all but one lamp may be suddenly turned off without moving rheostat or brushes, and without noticeable change in the brilliancy of the remaining lamp.

THE LOUISVILLE TORNADO.

ONCE in a great while the whole world is startled by such an appalling catastrophe as the Chicago fire of 1871 or the Boston conflagration of 1872. Such disasters are entirely

Grinnell, then we need not expect such a one again in about the same number, excepting as an increase in the size and frequency of towns in the tornado regions gives a more frequent opportunity for such accidents. This may also be said as true regarding the most serious fires.

Just preceding this tornado the atmospheric disturbance to the west and north-west of its development was unusually marked; so much so, that all the region in which the violent storms occurred were warned of their probable occurrence nearly twelve hours in advance by the Signal Office at Washington. The centre of the general storm at 7 A.M. (Central time), or twelve hours before the tornado, was in eastern Kansas, at which point the air-pressure was below 29.1

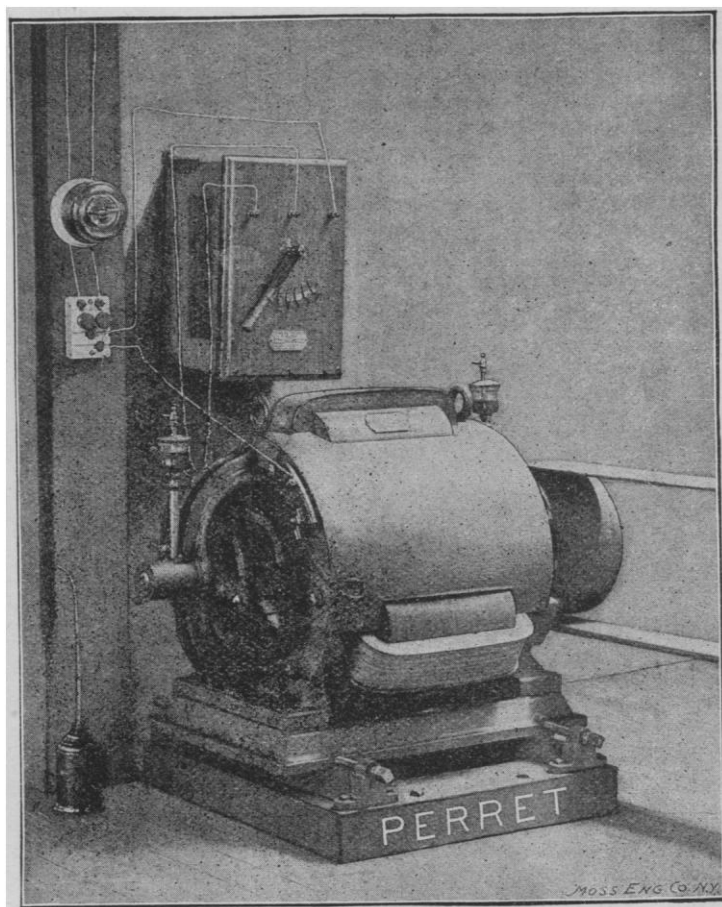


FIG. 3.—THE PERRET MULTIPOLAR ELECTRIC MOTOR.

outside of the usual experience, and thus make a most profound impression. Of such a character are to be regarded the Grinnell (Iowa) tornado of April 17, 1882, and the more recent one at Louisville on March 27, 1890, in which 76 people were killed and \$2,250,000 of property were destroyed. It might be thought that every tornado has exactly the same power, but does not show it because it does not happen to strike where it can do the most damage. To a certain extent we might argue in precisely the same way about a fire. Every fire, under such environments as mentioned above, would reproduce the terrible effects, but we find that the ordinary result of a fire is far different; and this is exactly the truth in regard to tornadoes. No two tornadoes are alike in their diameter or force. We may argue, however, that if two thousand tornadoes have produced one such as that at

inches. At 7 P.M. this storm had moved rapidly to central Illinois, and just fifty-seven minutes later Louisville was struck and partly destroyed. This fact, that we have a chart of the meteorological conditions within an hour of this outburst, is very important. We find that the winds throughout the tornado region were from the south and south-east; and this current existed even up to the clouds, as we have determined in so many cases before. In fact, the whole circulation of the atmosphere was no whit different from that noted again and again in such general storms. The tornadoes were suddenly thrown into this atmospheric circulation almost without warning. The velocity of the general storm, moving nearly due east, was 38 miles per hour from 7 to 11 A.M. of March 27, 39 miles per hour in the next four hours, and 37 miles per hour in the four hours just

preceding the tornadoes. It is a little difficult to obtain the exact velocity of the tornadoes, as the times are in most cases very indefinite; but the best authenticated times in the Louisville outburst would make it a little more than 80 miles per hour, the path being directed nearly north-east. There was a most remarkable series of tornadoes in this region, including southern Illinois and Indiana, western Kentucky, and just the northern border of Tennessee. The paths were all in a north-east direction, the earlier being 200 miles nearer the centre of the general storm, and much shorter than the later.

The first definite notice of a violent rush of air was at Mill Creek, Ill., at 4.30 P.M. This track (I) was very short, and is not traced outside of the town. Track II runs a short distance near Olney, Ill., and the time was 5.30 P.M. Track III was much the longest, and most destructive of all. It was first noted at 5.30 P.M., at Metropolis, Ill., and passed through or near the following towns (all in Kentucky), dipping now and then as it rushed onward at 80 miles per hour,—Hampton at 5.40; Marion at 6; Clay at 6; Dixon, Sebree, West Louisville, Delaware, Owensboro, at 6.17; Enterprise, Knottsville, Hawesville, Louisville, at 7.57,—and is last heard of in Jeffersonville, Ind., just across the river from Louisville. Track IV first appears at Farmington, Ky., and passes near Kuttawa, Eddyville at 6.30, Bremen, and Hartford, all in Kentucky. Track V is traced near Bellevue, Caledonia, and Sinking Fork, in Kentucky. Track VI may possibly be connected with III, and is traceable near Eminence, Pleasureville at 8.30, La Grange at 8.50, Campbellburg, and Carrollton, all in Kentucky. Track VII passes near Rogana, Tenn., at 8.30; Eulia, Tenn.; Coatstown, Tenn., at 8.50; Dixon's Springs, Tenn. (probably); Butlersville, Ky.; and Glasgow, Ky., at 9. Track VIII is traced near Fayetteville, Fosterville at 9.15, Millersburg at 9.15, all in Tennessee. Track IX is near Rockcastle Springs, Ky., at 11. The last violent wind, or track X, is found at Marshall, Ky., at 8.30.

It will be understood, that, though all this region felt these violent wind-rushes, yet these paths are by no means continuous from town to town, and in most cases there was no serious damage. Louisville suffered the worst, as just noted. Outside of Louisville there were 59 killed and a property loss of \$1,000,000. At Metropolis, Ill., 1 person was killed, 50 injured, and the property loss was \$150,000. The most exaggerated reports of losses were circulated by the newspapers. One prominent Western paper, whose statement was widely copied by others, a whole month afterward placed the loss in Webster County, Ky., alone at 111, while the true loss was 8. In Barren County the loss was placed at 30, though no one was killed there. In Lyons County 23 killed were given, though but 2 died there. This same paper made no mention of loss of life in Livingston County, where 9 were killed, and in 6 other counties where an aggregate of 40 were killed. Of course, there was no intention of distorting facts in this case: it is given as a simple illustration of the great difficulty which inheres in studies of this kind, and the great danger there is in taking descriptions by two or more observers of the same destruction, and applying them to several places, and not to a single spot. The utmost care should be exercised in giving the exact place of the catastrophe, either as in a town or village, or so many miles in any direction, as the case may be.

While the names of a large number of towns have been given above as visited on this date, yet there were many others that could not be enumerated for lack of space: in fact, a thorough research would seek to establish exactly the spots where destruction was least, as well as where it was greatest. It is quite remarkable that though this whole region was in a disturbed condition, meteorologically speaking, yet there were enormous areas not seriously touched. A careful research would have developed some valuable facts; but, so far as known, the only outburst given a careful study was at Louisville. It is to be deplored that such a fine opportunity to add to our knowledge of these storms was lost. We may hope that in the near future such occasions will be seized upon as of the greatest importance. It is probable that the weather service of each State would be best suited to take up this study, and it is noted that the Ohio Weather Service has exhibited commendable zeal in this regard.

There has been published in the *Weather Review* a good description by Sergeant Frank Burke of the tornado at Louisville, Ky., and this will be freely quoted from. The times given are all reduced to Central. "At 7.30 P.M., although intense darkness precluded careful observation, the clouds in the south-west exhibited evidence of a most violent commotion. It appeared as though north-west and south-west clouds, in coming into contact, had been shattered to pieces, and their fragments, intermingling, had been thrown upward and laterally by the force of the shock. These movements occurred at a considerable elevation, the space between the clouds and the earth having a misty or fog-like condition. Heavy rain began almost at the moment of this commotion. At the same time the lightning-flashes, which had occurred hitherto only at long intervals, increased tenfold in frequency and intensity, the south-west quarter of the heavens being the centre from which the almost incessant flashes radiated. A peculiar feature of this display was the almost entire absence of thunder. The wind had been blowing a moderate breeze from the south-east during the afternoon. At 7.34 it shifted suddenly to the south-west, and increased in force. At 7.50 the rain had almost ceased. A few moments later, scattering hail fell, average diameter half an inch; then came a momentary lull in the wind, and a peculiar, indescribable oppressiveness of the atmosphere. The darkness was intensified at this moment by the sudden diminution of the gas-jets, which in many cases were extinguished. It may be important to state in this connection that the lights were not blown out, but failed through lack of pressure in the reservoir. The approach of the tornado was heralded by a tremendous roaring sound, mingled with the crash of falling buildings. The noise has been likened to that produced by the passage of a heavy train of cars over a bridge, a thousand times intensified. The storm struck the city at 18th Street and Broadway, crossed it in an almost due north-east direction, and at 7.57 left it at 7th and Water Streets. This time is verified by the telegraph officials, who noted it as the moment when their wires, which cross the tornado's track, ceased to work. Persons who saw the cloud coincide in stating that it was of a balloon or turnip shape, though the darkness and confusion precluded accurate observations of its movements. It was accompanied by a most terrific electric display, and several reliable persons assert

that balls of fire were playing about it. The highest wind recorded at the Signal Office, less than 1,800 feet from the path, was 36 miles per hour. After it had passed, the wind shifted suddenly to the west, and continued to blow from that point for twenty-four hours, and with increasing velocity, the record showing 42 miles per hour at 9 P.M. The sky was perfectly clear at 9.30 P.M., except a streak of very high and apparently motionless cirrus in the west. Shortly after this time the atmosphere became obscured by a peculiar haze or smoke, through which the moon shone with a reddish light.

"Where the tornado entered the city, the width of the path was a little more than 600 feet. As the cloud progressed, the width of its path increased to 1,500. There is no evidence that the tornado-cloud touched the ground at any point in Louisville. In nearly every case the destruction was confined to the upper floors of the demolished buildings, but comparatively few houses being totally ruined; and also a large proportion of the one-story structures in its path were uninjured. Churches, halls, warehouses, and other structures having but little interior support, suffered the most. To this fact is attributed the principal loss of life. At the Falls City Hall alone, where a large number had congregated, 44 were killed. Frame buildings invariably withstood the shock much better than those constructed of masonry. But few of the destroyed buildings bear evidence of being actually blown down by the whirl of the tornado-cloud itself, but their destruction was apparently caused rather by a lateral or vertical rush of air-currents centring toward it. The ruins and the disposition of the *débris* give ample evidence of this. The right [south] side of the storm-track, and in a less marked degree the left side, afforded numerous examples of the intensity of this lateral force. In both cases [i.e., on either side of the track] the sides of the buildings facing the storm were pulled out, the *débris* falling towards it [the track]. In many cases fragile articles, such as glassware, remained undisturbed. In the centre of the track the destruction was mainly due to a vertical force which lifted the roofs of the buildings. The roof of the Union Depot was lifted bodily, and deposited intact on the floor, immediately beneath its original location.

"The destroyed buildings were, as a rule, of a very unsubstantial character, being mainly ordinary brick dwellings, small stores, and warehouses. The Fort Nelson building, at 7th and Main Streets, is the most notable exception to the general destruction in the tornado path. This is a well-constructed six-story building, and, by its greater height than those surrounding it, was more exposed to the storm's fury. Despite the fact that it was directly in the storm's track, and that all other houses on either side were wrecked, it escaped with the loss of its windows. The gyratory motion of the tornado is well illustrated in the disposition of the prostrated trees in the parks, and the timber outside the city. In the centre the trees were piled in promiscuous heaps, denoting a tremendous wrenching or twisting force. On the right side the tree-tops point almost north-east; those on the left side, nearer due east. Throughout the path of the storm the zone of destruction on the right [south] side is more than twice as wide as that on the left side, and shows a much greater intensity of force."

I have quoted almost the whole of Mr. Burke's most ex-

cellent report, which may be regarded as a model in its terseness and statement of valuable facts. One or two comments are added. The heavy rain preceding the tornado seems to have been independent of it, and not necessarily due to any action in it. The presence of lightning, and absence of thunder, are noteworthy, and may explain the fact that oftentimes no electric action is reported in a tornado. Thunder is always regarded as the most prominent characteristic in a thunder-storm. The sudden shifting of the wind to a direction from the tornado is very significant. How could this have been if there were a partial vacuum in the storm? The failure of the gaslights is very interesting, and at first sight appears to show a marked diminution in pressure. Diligent inquiry at a gas-office, however, shows that no reasonable diminution in the pressure of the atmosphere could affect a gaslight; moreover, this same phenomenon was noted at Cleveland, O., at a time when there was a very high wind, but no tornado. Investigation has shown that a high wind forces the immense gas-holder against the vertical posts, and this causes the failure in the pressure. This explanation is now accepted by those familiar with the subject. It seems also probable that such a high wind, when blowing near the earth, would have a tendency to an upward thrust; and this has been shown repeatedly by the uplift of dust, leaves, and small branches in front of a sudden gust. The increasing wind after the tornado was not connected in any way with that, but was simply the high wind in the rear of a storm, and in this case it was intensified by the steep barometric gradient. The preservation of the Fort Nelson building was probably due to a diminution in, or a lifting-up of, the storm just at that point, and not to its construction. There are innumerable instances in which the frailest structures have been left undisturbed in the centre of a tornado-track. The evidence from the prostrated trees does not bear out the gyratory theory, but is rather strongly against it. If there were any gyration, say, from right to left, the trees on the left (north) side ought to face west, and not east as they were reported.

Mr. Burke, in a private correspondence, states that he made a most diligent search for evidence of corks being blown from bottles, but did not find a single case, although there were several apothecary-shops and bottling-establishments in the centre of the track. He also states that the diminution in the gaslights was quite sudden, and passed away quickly. It would be interesting if some one would determine the velocity of the wind needed to produce this effect. This report must be regarded as corroborative, and not as absolutely establishing points now in doubt. The statements in the report show only very slight evidence of bias or leaning toward any theory; and this is just what is needed now, if we are to make any headway in our studies. The report is worthy of commendation.

Incidentally one of the more interesting facts brought out by the tornadoes on this date are barograph traces made by the passage of the tornado at Owensboro, Ky., and Cincinnati, O. These are given in the accompanying plate, Figs. 6 and 7. Unfortunately the original trace for Fig. 6 was carried by the owner to Scotland, and given to Mr. Buchan, who rightly regarded it as a most valuable acquisition. It is to be regretted that the original was not kept in this country, where it belongs, and a copy taken abroad. The copy

I have, however, is a fair representation of the original. I have enlarged Figs. 5, 6, and 7 from the Richard barograph to make them directly comparable with the barograph sheet at Washington, given in Fig. 8. The barograph at Owensboro was a mile and a half from the nearest point of the tornado. It has been supposed all along that a tornado could not produce any effect on pressure more than a few hundred feet from its centre, but here seems to be good evidence of an effect over 7,000 feet away. The first sudden drop of the curve with an immediate return is a little singular, and appears like the sudden drop found by others, and explained by the effect of the wind. Whatever may have caused this drop, there is no doubt of the rise after it;

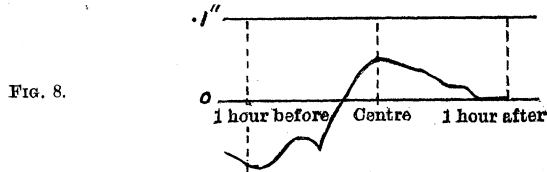
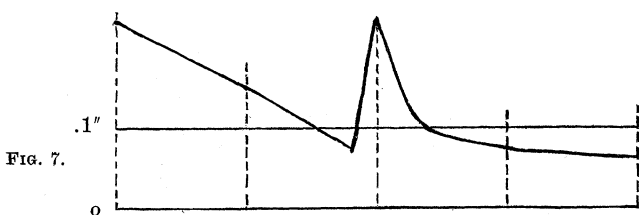
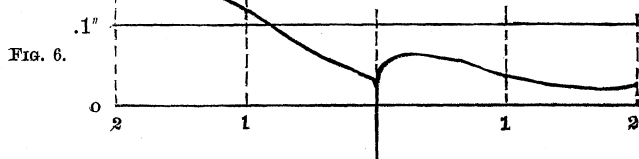
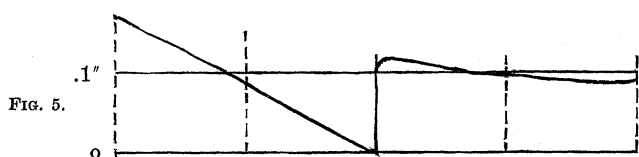


Fig. 5, tornado St. Louis, Mo. (Jan. 12, 1890, 5.16 P.M.); Fig. 6, tornado Owensboro, Ky. (March 27, 1890, 6.17 P.M.); Fig. 7, tornado Cincinnati, O. (March 27, 1890, 8.20 P.M.); Fig. 8, thunder-storm Washington, D.C. (June 22, 1890, 9.8 P.M.).

and this rise is far more striking at Cincinnati, where the storm crossed 59 minutes after leaving Louisville. Fig. 5 is also given from the barograph at St. Louis during the tornado of Jan. 12 of this year. This has already been referred to. There is no doubt of a marked rise here. Fig. 8 is a portion of the pressure-curve made at Washington, D.C., during the prevalence of one of the most severe thunderstorms that has visited the station. There was a steady rise for an hour, and a less rapid fall after the centre had passed. This storm came up and passed off very slowly, and was attended by most brilliant lightning and a terrific wind. The general similarity in these curves, excepting Fig. 6, is very striking. We may hope to get more of such curves on both sides, and possibly in the centre of tornado-tracks.

Instructions for Observing Tornadoes.

If any one thing has been emphasized in these pages, it has been the extreme need of more light on this whole ques-

tion. The earlier investigators of the phenomenon were untrammelled, to a large extent, by preconceived opinions, and it must strike every one that few substantial facts unknown to them have been brought out since their time. It is to be hoped that the number of those willing to aid in establishing the facts and ferreting out the mysteries will be largely increased, and it is for such these instructions are given.

1. It is very essential that one divests himself of every preconceived notion about the whirling, sucking, or any other action of a tornado. There is the utmost danger of seeing the tornado do what we think it ought to do. It would be far safer, if one has an inclination to such views, to deny that such a view is correct, and only to accept it after most incontestable proof.

2. Note the time of day carefully, and specify whether the time used is Eastern, Central, Mountain, or some city time.

3. The side of the track on which the observer stood should be given.

4. Note the appearance of the clouds in the distance,—whether they roll upward, come together from the north and south,—or any other phenomenon connected with them.

5. Special note should be made of a cloud of dust and its general appearance.

6. See whether the funnel-cloud is visible at a distance, or suddenly breaks into view on the approach of the tornado. If possible, locate the first appearance of the funnel by a tree, house, or object close by, and, after the tornado has passed, measure the distance from the observer's position to that of the tornado when first seen.

7. If the observer is a thousand feet or more away from the funnel, or cannot see distinctly trees or objects in it or near it, he should not try to make detailed observations of the whirl, or any thing else at the tornado. Fix the attention on the motion of detached clouds. Make every effort, by comparison with trees and houses between the tornado and the observer, to get its height, width, and speed: these can be much better found out at a little distance than close to the cloud.

8. Make careful observations of all electric displays, the appearance of balls of fire, the sound of thunder, the roar of the tornado, etc.

9. If the observer is within a hundred feet of the tornado on the north side, he need have no fear, and may carefully examine all objects flying just above the ground. He should note carefully the foot, the middle, and the top of the funnel, to see whether any tree or object is carried to his right as he faces the funnel.

10. Note also whether any object is carried up straight in the funnel, or whether it is borne along in the swift wind. If there is an uprush in the tornado, it ought to be easily told; and the appearance will be very different from that if the object or house is borne along by the wind, and afterward inclined upward. If there is a sort of explosive effect, the upward motion will be more or less jerky, and not steady as in a stream. On the whole, the evidence seems to show something like an uprush, though it seems conclusive that this is not due to a vacuum in the tornado, as many think. It is very plain that nothing can be sucked into the tornado, because of a partial vacuum there; but if it rushes in or up, it must be borne or propelled by a stream of electricity, so to speak, or by a rush of air. One of the best illustrations of

this has just come to hand from the storm at Bradshaw, Neb. This tornado passed over a tank ten feet long, three feet wide, and twenty inches deep, full of water. This tank was air-tight, and had an opening in the top one foot square. The observer reports that the tornado sucked all the water out of this tank. A moment's reflection will show that this could have been done only by the insertion of the funnel into the opening one foot square. Of course this is absurd, and we must resort to some other explanation of the phenomenon.

11. After the tornado has passed, note the appearance of the houses for explosive effects.

12. Pay particular attention to the direction of the trees, making a separate observation on the south side, in the centre, and on the north side. See if any *débris* or objects have been carried in any case toward the west or south-west on the north side of the track, and measure the distance.

13. A note should be made of the width of the greatest destruction, not including houses unroofed on the borders; also the length of the path where it was most destructive, and the distance from the point at which it first struck the earth to the point at which it left the earth during the time of the greatest destruction.

14. Give the names of persons killed, if any.

15. Give an estimate of the loss to buildings, also specifying the number of buildings destroyed and their characters as to strength, etc.

16. A note should be made of the rainfall,—whether it was most abundant before, during, or after the tornado; also, if possible, the amount of rain at the centre of the track and at some point two thousand or three thousand feet on either side.

17. Careful note should be made of hail, size of stones, width of track, situation with respect to the main track, etc.

18. After the tornado the direction of the path should be most carefully determined.

19. All evidences of corks flying from bottles should be carefully looked for.

20. If one has a barograph, its record will be of the utmost value. If one has a barometer, an observation should be made by some one every minute till the tornado has passed. If the barometer is an aneroid, the face should be gently tapped before each observation. A steady watch of the needle may show any sudden fluctuation too rapid to be caught by reading the barometer. This instrument may be read in a dug-out or a cellar as well as in a house.

Of course, every one will keep eyes and ears open for any and all phenomena to be noted in this remarkable outburst.

H. A. HAZEN.

NOTES AND NEWS.

In *Science* of July 25, second column, 36th line from the bottom, "*cenoreus*" should read "*cinereus*."

—A census taken in St. Petersburg in December, 1889, proved that during the previous twelve months the number of inhabitants had increased by 25,006, and had attained to a total of 1,003,315, says *The Scottish Geographical Magazine*. Attention is drawn to three noteworthy points regarding the population: the first is that the increase is greater in the suburbs than in the heart of the city; in the second place, the ratio of women to men has increased during the last twenty years, probably in consequence of a greater demand for female labor; lastly, since 1885 the births have been more numerous than the deaths, by 2,750 yearly.

—Some discussion has been going on in Ceylon over the question of the language spoken by the Veddahs, the aborigines of that country. The subject, says the *Colonies and India*, would seem to be one well worthy the attention of philologists; and the brothers Sarasin, who have been pursuing their anthropological researches in Ceylon, express the opinion, that, if a philologist were to take the matter up, great service would be rendered to all those engaged in the work of scientific research in the island. Tennant says of the Veddahs (*Nature*, July 17), "Their language, which is limited to a very few words, is a dialect of Singhalese without any admixture from the Sanscrit or Pali,—a circumstance indicative of their repugnance to intercourse with strangers." Professor Schmidt of the Leipzig University, who visited the Veddahs last year, says, "Their language is similar in construction to the Dravidian languages,—that is, similar in grammatical construction,—but they have adopted a great number of Singhalese words," which enabled him to hold converse with them by means of a Singhalese interpreter. The Drs. Sarasin also managed to make themselves understood by means of Singhalese.

—A recent exhibition of electrically deposited copper in London, England, attracted much attention from persons interested in the use of that metal, particularly for steam-pipes and electric conductors. There were shown copper pipes of all sizes, from 6 inches to 18 inches in diameter by about 10 feet in length, and ranging from one-sixteenth to three-eighths of an inch in thickness. They were prepared by an electrical copper-depositing process, on a commercial scale, from common Chili bars without any intermediate process. The bars are placed as the anode in an electrolytic bath, and the tubes are deposited direct on a rotating mandrel, each individual atom of metal being rubbed into those surrounding it by an agate burnisher. The result is a metal having a tensile strength of 25 tons per square inch, with 20 per cent elongation, and of such purity that when drawn into wire it has an electrical conductivity of 104, or 4 per cent better than the standard. This metal is so ductile that it can be drawn down, without any annealing whatever, till it takes forty miles to weigh a pound.

—The Engle garbage-cremator, which has been illustrated and described in these columns, is being successfully introduced in various parts of the country, especially in the South. In Tampa, Fla., one has been constructed of a capacity sufficient to dispose of that city's refuse. An official test, made previous to formal acceptance of the cremator by the authorities, was described in a recent issue of the *Tampa Tribune*. According to that paper, an accurate account kept, showed that in about seven hours' actual running time the furnace destroyed twenty cubic yards of night-soil and garbage, much of the latter being completely saturated with water, and containing large quantities of melons and melon-rinds. The fuel used was light wood, of which about one-quarter of a cord was burned, and three-quarters of a cord of slabs and waste refuse lumber. As nearly as can be stated, the operation of the furnace showed that it would destroy at least forty cubic yards of material in twelve hours, and would require about three-quarters of a cord of light wood during that time. The furnace has been formally accepted and paid for by the city, and will at once be put into active use.

—The council of the Scottish Meteorological Society refer, in a report made July 14, to the observations of Mr. Rankin on the number of dust-particles in the atmosphere, carried on with two sets of apparatus invented by Mr. Aitken. *Nature* states that, though it would be premature to offer a statement of positive results, the council think that some interesting conclusions appear to be indicated by the observations. The maximum number of dust-particles in a cubic centimetre hitherto observed is 12,862, on March 31; and the minimum, 50, on June 15. On March 31, at 4 30 P.M., the summit was clear, and the number of particles was 2,785; but shortly thereafter a thickness was seen approaching from south-west, which by 6 P.M. reached the observatory, and the number of particles rose to 12,862. On June 15 many observations were made during the day, when the number of particles fell from 937 at midnight, to 50 at 10.30 and 11.42 A.M. The observations point to a daily maximum during the afternoon

minimum barometer, and a minimum during the morning minimum barometer, these being probably intimately connected with the diurnal ascending and descending currents of the atmosphere. Interesting intimate relations are also indicated between the numbers of dust-particles and the cyclones and anticyclones over north-western Europe at the time. The observations also indicate that the dust-particles may vary enormously during the presence of mist or fog, without being accompanied by any difference in the apparent density of the fog. The council consider that the inquiry is an extremely hopeful one; and, in view of the relations with cyclones and anticyclones, its bearings as regards the forecasts of the weather will be very specially investigated.

—For several years past it has been the practice of the Indian Meteorological Department to issue in the month of June a forecast of the prospects of the monsoon rains, based partly on the reported extent and thickness of the Himalayan snows, partly on the distribution of the atmospheric pressure, the small variations of which are found by experience to be remarkably persistent in India, and to serve as an indication of the probable strength of the monsoon, and alternately of the prevalence of dry land winds. The forecast for the forthcoming season announces, according to *Nature* of July 17, that owing to the very slight snowfall of Afghanistan, Baluchistan, and almost the whole of the Himalayan region, the conditions are eminently favorable for a good strong monsoon. The only unfavorable indication is that the winter of 1889 has been very severe in Yarkand, and perhaps in other distant parts of central Asia. The pressure is unusually low this year in Bengal, and above the average in central India and the northern half of Bombay; and the local pressure conditions considerably resemble those of 1876. It is therefore considered probable, that while the eastern half of the Ganges valley, Assam, and Burmah will receive early and abundant rain, the rains may be late and scanty over a considerable area of north-western India.

—Recently Mr. S. F. Menage of Minneapolis very liberally agreed to fit out a scientific expedition to the Philippine Islands. Messrs. D. C. Worcester and F. S. Bournes of the University of Michigan were willing to go, and on July 22 they left Minneapolis for Vancouver's Island, *en route* to Manila. They purpose remaining in the Archipelago for at least two years, and during that time they will prosecute the work of zoological and botanical collecting under the most favorable auspices. While specializing upon birds and corals, they will not limit themselves to these, but intend to make collections of *Entomostraca*, fungi, fresh-water *Algæ*, *Mammalia*, and flowering plants. They will give some special attention, moreover, to the land-shells of the islands, many of which present most curious problems of descent and distribution. The large collections which will be made, if no unforeseen accidents occur, are to be worked over under the auspices of the Minnesota Academy of Sciences, and will be deposited in its museums for the use of scientific men. Both Mr. Worcester and Mr. Bournes are experienced zoologists, and Mr. Worcester was for some time instructor of botany in the University of Michigan: so they are well qualified to undertake the study of so diverse and little known a fauna and flora as that of the Philippine Islands. The thanks of American botanists and zoologists are due Mr. S. F. Menage, who so generously endowed the expedition. From its results of real scientific value may be confidently expected.

—That the latitude of a place is not constant has long been suspected; but it was only at the end of last year that systematic observations, carried out at some of the observatories of central Europe, clearly established the fact by eliminating all chances of error in instruments and observers. Professor Helmert reported in No. 2,963 of the *Astronomische Nachrichten* that the latitudes of Berlin and Potsdam, which had shown no perceptible variation during the first six months of 1889, in the third quarter of that year increased at first, and then diminished, the movement continuing till January, 1890. In Berlin and Potsdam this decrease amounted to from five to six inches, and this variation was confirmed by observations at Prague and Strasbourg, the results at the first three observatories agreeing to within one-tenth of a second. According to *The Scottish Geographical Magazine*, the subject is to be discussed at the meeting of the Commission for In-

ternational Geodesy, to be held in Freiburg next September, when, it is to be hoped, arrangements will be made for a strict examination of this phenomenon.

—The population of Iceland has for several years been decreasing, owing to the strong tide of emigration to America. It is stated in *The Scottish Geographical Magazine* that the population in 1888 was 69,224, whereas in the preceding year it amounted to 69,641, and in 1885 to 71,618. This phenomenon is most marked in the northern and eastern parts of the island. The growth of the population of Reykjavik, the capital, from 3,460 in 1885 to 3,599 in 1888, shows that the tendency of population to concentration in towns prevails also in Iceland.

—Many of the workmen who were employed in the caissons of the East River, Forth, and other bridges, suffered severely from the effects of working in an atmosphere of compressed air, as do those now employed in the tunnel under the Hudson River. During the construction of the Forth Bridge piers, it was noticed that the sufferers were in the habit of spending their Sundays and Saturday half-holidays in the air-chamber, thereby finding relief from their pain. Acting on the idea suggested by this fact, Mr. Moir, the engineer in charge of the Hudson River Tunnel, has had constructed a compressed-air hospital for the men employed in the tunnel, among whom there have been several severe cases of "bends," although the air-pressure is not particularly high; never, indeed, exceeding thirty pounds per square inch. The hospital, as described in *Engineering*, is a cylinder 18 feet long by 6 feet in diameter, constructed of steel plates three-eighths of an inch and half an inch thick, and divided into two chambers by a transverse bulkhead. One of these chambers acts as an air-lock for the other, and both are fitted up with beds and every thing necessary for the comfort of the patients. The air-pressure is maintained by a pump, a constant supply of fresh air being secured by keeping a pet-cock in the shell of the hospital open, through which the air continually leaks out. A safety-valve is also supplied to prevent over-pressure, should the pumps run away.

—A long article by Dr. von Danckelman, containing details concerning the atmospheric phenomena of the Guinea coast, is thus summed up in *The Scottish Geographical Magazine* for July: "These depend in the main on the atmospheric pressure over the lands of North Africa, and especially the Sahara, where the mean temperature in summer rises above 98° F. The low pressure thus produced draws in the air from all sides to restore equilibrium. Hence the prevalent winds on the Guinea coast during this season are the south and south-west; while in winter the contrary phenomenon occurs, except sometimes on the shore, where the higher temperature of the land maintains a continuance of southerly breezes. The highest pressure occurs in July and August, and the lowest in February and March. The range of the monthly mean is small, amounting only to from .14 to .18 of an inch. As regards temperature, it is found that the maximum occurs in February and April, and the minimum in July or August. The mean daily range is nearly twice as great in the hottest season as in the coldest, and increases considerably towards the interior. In Bismarckburg the mean maximum (in March) was 87.7° F., and the minimum (in July and August) 65.3°, and the maximum and minimum ranges 23.6° and 13.8° respectively. At Akassa the average daily range is only 10°, while at Bismarckburg it is 18.5°. Turning now to the rainfall, it appears that a rainy season of four months sets in shortly before the sun reaches the zenith, which it does in the beginning of April, and that the maximum fall occurs in May and June. About the latter part of June, the dry season commences, and lasts till the middle, and sometimes the end, of September. The yearly rainfall at Bismarckburg is over 59 inches; at Accra, 29; at Christiansborg, 22.6. Half the storms come from directions lying between north-east and south-east, most of them from the north-east. Tornadoes are most frequent before the commencement of the rainy season. The most singular phenomenon on this coast is the *Harmattan*, a dry wind, laden with dust, and often bringing with it hazy and cloudy weather. On the Senegal it follows an east to east-south-easterly direction; on the Gold Coast and near the mouth of the Niger, a more northerly course; and it blows most frequently in December and February."

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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THE SITE OF KARAKORUM.

At the meeting of the Geographical Society of Paris held on the 23d of May last, M. N. Yadrintzeff, the well-known Siberian traveller, read a paper upon the archaeological mission in North Mongolia, with which he was intrusted by the Irkutsk section of the Imperial Geographical Society of Russia. The special object of the expedition, as we learn from the "Proceedings of the Royal Geographical Society," was to determine the exact site of the city of Karakorum, the ancient capital of the Khans of Mongolia, — a question which has long been in dispute ever since the visit of Marco Polo. M. Yadrintzeff started from Kiakhta on the 10th of June, 1889, and followed the course of the Selenga to the point where it debouches into the Orkhon. The first ruins were met with on the river Tula; viz., those of the ancient abode of Irkhe-Merghan, son of Altai Khan, which dates back from the thirteenth century. Several parts of the ruins were in a very fair state of preservation. On June 23 the expedition visited the remains of an ancient Buddhist temple on the river Kharukha, the walls of which are still from twenty to forty feet high, and nine days later arrived at the celebrated ruins of Kara-Balgassun, situated on the left bank of the Orkhon, about thirty miles south of its confluence with the Urtu-Tamir. A close examination of these ruins convinced the traveller that they formed the remains of an ancient city, which must have covered an area six miles in circumference, and the centre of which, the Kara-Balgassun of to-day, was occupied by the principal palace of the Khan. Canals connected this

city with the river Djirmanta. In the vicinity of the hot springs, near the latter river, the remains of baths were found. The position of the ancient capital of the Mongolian Empire can thus be accurately fixed, thanks to the recent astronomical determination of the situation of Lake Ughei-Nor, made by Col. Pievtzof. The lake lies in latitude $47^{\circ} 47' 23''$ north, and longitude $102^{\circ} 45' 25''$ east of Greenwich; and the position of Karakorum is, according to M. Yadrintzeff, thirty miles to the south-east, or in latitude $47^{\circ} 15'$ north, and longitude $102^{\circ} 20' 15''$ east of Greenwich. Another result of this expedition is the discovery of remains of the ancient habitations of the Mongols along the whole valley of the Orkhon. Several burial-grounds visited by the expedition were full of stones covered with inscriptions, bas reliefs, and obelisks. Most of the latter have Runic inscriptions and Chinese hieroglyphics. The tombs bear evidence of great antiquity, and apparently belonged to the ancient nobles of the country. A visit was also paid to the Buddhist convent of Erdenitzan, where an important religious festival was witnessed, in which more than two thousand lamas took part.

A DRILL TO CUT SQUARE HOLES.

THERE have been attempts at various times to devise a drill which would produce square holes as economically as round holes are drilled. The idea has been a favorite one with inventors, but hitherto no great amount of success has attended their efforts. Recently, however, machines for the purpose have been devised that work with some degree of success. Two of them are now on exhibition in London. As described in *Engineering*, they bear a general resemblance to drilling-machines; but the spindle, instead of revolving in close-fitting bearings, has a peculiar motion which causes it to cut out a square hole. In the earlier type of machine the spindle is fed down through a long rotating sleeve. This sleeve is made to follow a path of peculiar form by means of a cam at each end running in a square hole. The method of setting out the cams is thus explained: "A square hole is described equal to the hole to be drilled. From any point in one side of the square an arc of a circle is described with a radius equal to the side of the square. From the points where this arc intersects the sides of the square, other equal arcs are described, completing the curve triangle. The square in which the cam is to revolve is now drawn, and from each of the vertices of the curve triangle two arcs are described, which complete the figure shown. The point of the tool, which cuts with one edge only, must be situated beneath one of the angles of the triangle." There are a separate pair of cams and a separate tool for each size of hole to be drilled. Five sets of cams are fixed on the spindle, and any set of them can be placed opposite the bearing-plates. The later form of machine is simpler in its construction, and will drill any sized hole within the range which it covers. In the upper bearing there is a short hollow spindle which is driven by gearing. Through this spindle there passes a long hollow spindle, carried near its lower end in a ball-bearing which allows considerable freedom. At the upper end of the spindle there is a roller which runs in a fixed cam path, and is held up to it by springs, which connect the spindle with the hollow driving-spindle. The effect of this arrangement is, that while the spindle rotates, it also rolls round in the ball-bearing, and its lower end describes a geometrical figure. The drill-spindle proper is within the second spindle, and carries a cutter, the cutting edge of which terminates on the centre line of the spindle. As the central spindle is raised or lowered, it decreases or enlarges the size of the hole drilled, while the whole drill-head is lowered to give the feed.

HEALTH MATTERS.

Microbes in Hail-Stones.

BACTERIA of various kinds have been found in ice and snow; and Dr. Fontin, a Russian observer, has now proved that hail-stones are not free from them. He has found, says the *British Medical Journal*, that the water produced by the melting of hail-stones contains, on an average, 729 bacteria per cubic centimetre. Neither yeast fungus nor mould was present, but nine different kinds of

bacteria were found, five of which (*B. mycoides*, *liquefaciens*, *luteus*, *sarcina lutea*, and *aurantiaca*) are already known. As the ordinary dwelling-place of the *Bacillus mycoides* is the earth, we are confronted with the fact that microbes of terrestrial origin may be carried up into the air, and thus rain, snow, and hail may be the direct means of conveying infection.

Mechanism of Respiration in the New-Born.

Dohen, from a study of this subject at the clinic of Königsberg, reaches the following conclusions, as we learn from *The Brooklyn Medical Journal*: 1. The respiration of the new-born is thoracic. 2. The elevation of the thorax begins at the summit, and descends progressively. 3. The tidal air averages 35 cubic centimetres, and reaches a maximum of 120. 4. The exchange of air is feeble in the first days after birth; at the end of the first week is a third larger than the first day. 5. Generally at the first inspiration the lungs are not filled with air, the alveoli unfolding only on the second day (a fact of medico-legal importance). 6. The respiratory curves of the new-born present no stationary points.

The Art of Medicine vs. the Science.

What Emerson said of the poet is applicable in its degree to the true physician: "As the eyes of Lynceus were said to see through the earth, so the poet turns the world to glass, and shows us all things in their right series and procession: for through that better perception he stands one step nearer to things, and sees the flowing or metamorphosis. . . . The poet alone knows astronomy, chemistry, vegetation, and animation; for he does not stop at these facts, but employs them as signs." It is not enough for the physician to know anatomy, physiology, chemistry, and pharmacology: he must not stop at knowing these, but must put them into the alembic of his brain, and transmute them into medical science. It is stated in the *British Medical Journal* that Professor Huxley said that it would be simply manslaughter for a doctor to treat his patients on the raw and undigested principles of physiology. Medicine must therefore never be looked upon as a mere science, because it is much more than that, it is wisdom sublimated from many sciences; and this is why the Gulls, the Jenners, and the Clarks can never be as common as the mere scientists who work by rule and scale. When Coleridge was accused of plagiarizing, in his "Hymn to Chamouni," from the poem of Frederica Brun on the same subject, it was easily explained, that, though he had taken her framework and used certain of her ideas, he had done so simply to glorify and endow them with life. With her they were dead phrases: Coleridge created the "Hymn to Chamouni" out of them. Just in proportion as the physician can create diagnosis and treatment for the cases which come before him as living and as various as the patients which are the subjects of the different diseases, just by so much is he a true physician. The inferior mind may see the same things as the superior, but the latter alone "sees their flowing and metamorphosis." This is why patients would go and talk to Sir William Gull, and derive benefit from the conversation, though they came away with no prescription, and took no drugs from his hands. The vulgar mind cannot understand the reason of this, and the hard scientist smiles a little superiorly at the idea.

Heredity of Tuberculosis in Comparison with its Propagation.

Attention is called, in the *Lancet* of June 14, to a pamphlet on the above subject by Dr. A. Haupt, in which it is stated that among the 1,500 inhabitants of Soden there are 101 who let lodgings. In most of the houses the wives, with sisters or daughters, serve and tend the tuberculous patients who come for treatment. In many houses servant-girls from the neighboring villages, hired for the summer, help, making the patients' beds, cleaning their rooms, beating the carpets, removing the sputum. These occupations, so closely connected with the danger of infection, are, among others, the tasks of these persons; and it must be added that they prefer the severest cases, because, as more help is required, the remuneration is higher. In winter the members of the landlords' families occupy the rooms in which generally the most severely affected patients have lain,—the rooms on the ground floor. Between 1855 and 1888, 48 of the 233 members of such families

died, 10 of them of tuberculosis. In 6 of these 10 cases, heredity was demonstrable, and the remaining 4 were due to colds and external causes. Of the 415 servant-girls, 17 died, 5 of them of tuberculosis, also demonstrably due to other causes than infection. Within 30 years, then, among 653 persons, most of whom were for several summers with and in attendance on the patients, there were 15 deaths from tuberculosis, none caused by infection. The same proportion prevails among other persons in close contact with consumptive patients, attendants, washerwomen, etc. As to the general mortality of Soden, the following data are interesting: 76 persons died during the last three years, 10 aged from 80 to 85, 11 from 70 to 80, 9 from 60 to 70. Of these 76 deaths, 7 were due to tuberculosis, including 2 cases of tuberculosis meningitis in children, and 1 of tuberculosis of the bones, also in a child. Of the 4 other cases, only 1 was that of a person who came in contact with patients, and this was a case of alcoholism, ending in phthisis.

The Transmission of Typhoid-Fever by the Air.

Dr. Bordas, as we learn from a contemporary medical journal, has instituted experiments to determine the relation between the humidity of the atmosphere and the transmission of the typhoid bacillus. A current of dry air completely devoid of germs was conducted through a vessel containing a beef-broth culture of the bacillus, and into a second vessel containing sterilized beef-broth. The second vessel remained sterile. The result was the same when a dry atmospheric current was passed over pumice-stone saturated with a culture of the typhoid bacillus. When moist air was passed through the same vessels, a very different result was obtained. The sterile beef-broth culture was found, after the lapse of a quarter of an hour, to be thickly planted with the bacilli.

In nature this state of humidity is supplied by mist or fog, and statistics show an increase of typhoid-fever in Paris during the months of October, November, December, and January. The most general mode of propagation of typhoid-fever is by the contamination of the soil or water, but there are cases in which it is manifested by pulmonary localization. The germ may penetrate into the bronchial system, in spite of every means of defence possessed by the organism. Metchnikoff's studies prove that the lungs are a phagocyte battle-ground. In typhoid infection, due primarily to pulmonary lesion, it would seem that the phagocytes of the lungs are ordinarily sufficient to prevent the development of the infectious germ, and that contagion by means of the air can take place only when the macrophagic cells cease to offer an obstacle to the invasion of the microbe.

LETTERS TO THE EDITOR.

. Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Temperature in Storms, and High Areas.

It is an axiom, that, in making any special investigation as to the relation of cause and effect, we must separate out all influences tending to confuse and mask the special cause or force which we are studying. We may form an abstract conception beforehand of what effect we may expect to follow a certain cause, but we shall be seriously misled if we allow this hypothesis to take the place of a careful analysis step by step in our investigation. For example: suppose we reason, regarding the deposition of dew, that a fleece of wool suspended horizontally six feet above grass ground will collect more dew than one on the ground, because the warm ground will give up its heat rapidly, and prevent the lower fleece from cooling as much as the other. If we try the experiment, we shall find our reasoning entirely disproved by the facts. We have ignored the fact that the air near the upper fleece is in constant motion, and also that the heat of the earth cannot communicate itself to the tips of the wool fibres. Again: if we wish to find the pressure of the air at Mount Washington, for example, we may reason that since the pressure at

Portland, Me., which indicates the total pressure to the top of the atmosphere, is 29.93 inches in January, and 29.81 inches in July, therefore the pressure at Mount Washington must be .12 of an inch lower in July than in January. This would be vicious reasoning, however, because we have ignored the fact that it is warmer in July than in January, and consequently there is more air above the mountain in the former month. If we put the question to nature, we shall find that the pressure, instead of being less in July, is actually half an inch more on the mountain.

We might at once conclude that there is a reversal of the usual conditions, and that instead of having high pressure with low temperature, and *vice versa*, as we are accustomed to note at the earth's surface, we have on the mountain high pressure with high temperature, and *vice versa*, and extend our theory to storms and high areas. It seems to me this would again be very vicious reasoning: in fact, since there is a reversal of the law of pressures between sea-level and at some height, it would be impossible to connect directly the fluctuations of temperature and pressure at the two situations. May we not consider that when a storm approaches a station at sea-level it brings with it a high temperature, owing to the south winds that blow toward it, and that this high temperature must extend to a great elevation in the atmosphere? In other words, why may we not study temperature conditions without considering the pressure at all? We find that in a storm the temperature may rise twenty to thirty degrees at the earth. Let us take out all the cases in which there is a marked rise and fall in temperature at sea-level, say ten degrees in two days, and determine the conditions at the height of Mount Washington for the same days. In the following table I have taken out the temperature at the maximum and minimum points at Burlington, Vt., during the months October, November, and December, 1873, and January, February, and March, 1874, and also the temperature for the three days before and after these points. The corresponding temperature for exactly the same dates at Mount Washington (6,279 feet) were taken out. There were found twenty cases at the maximum point, and the same number at the minimum. The mean of each ten of these cases is given in the table.

	MAXIMUM POINT.				MINIMUM POINT.			
	1st 10 cases.		2d 10 cases.		1st 10 cases.		2d 10 cases.	
	B.	W.	B.	W.	B.	W.	B.	W.
3 days before	32	20	29	18	48	34	41	24
2 " "	32	21	32	19	50	32	40	23
1 day "	44	34	42	25	42	26	35	18
At the.....	51	37	48	29	28	17	22	10
1 day after...	42	26	42	24	43	29	33	18
2 days after..	31	18	29	20	44	33	40	22
3 " "	35	20	36	22	49	32	39	24

These results agree for each ten days, and show, that, when there is a rise of about nineteen degrees before a storm at sea-level, there is a corresponding rise of about fourteen degrees at Mount Washington; and a fall after the storm at the earth of about fourteen degrees corresponds to a fall of about twelve degrees on the mountain. The same results in an opposite direction are still more prominent on the approach and advance of a high area. These results are strictly in accord with the teachings of the most prominent meteorologists, and it seems probable that these teachings must stand against all adverse criticisms. It is very remarkable that so self-evident a truth as that a storm brings with it an increased temperature to a very great height has been sharply assailed in certain quarters. The facts are certainly strongly against these new views, and we must conclude that they could not be sustained for a moment except by ignoring the axiom laid down at the beginning of this discussion. H. A. HAZEN.

Washington, D.C., July 28.

A Scintillating Meteor.

ON Saturday, July 19, at 8.52 P.M., I saw a meteor in the eastern sky, passing through an arc of about thirty degrees in a nearly horizontal direction, at a height of twenty-one degrees above the horizon. Its course was from the south to the north; and I estimate the time during which it was visible as three seconds, rather less than more. The point where its path ended was almost due east. The light it produced was as bright as that of a common arc-lamp at a distance of some two hundred or three hundred feet. There was no sound or other marked indication of a final explosion, but there was a succession of sparks or scintillations during the latter half of its path. A luminous streak, as usual, marked the path for some little time after.

J. A. UDDEN.

Augustana College, Rock Island, Ill., July 21.

BOOK-REVIEWS.

Elementary Physics. By MARK R. WRIGHT. London and New York, Longmans, Green, & Co. 12°. 80 cents.

THE author of this text-book is head master of the Higher Grade School, Gateshead, England. The book is suited for use in our high schools and academies, and should be examined by those looking for such a work. The plan is, by experiments which can be performed with apparatus readily constructed, to make the student familiar with the facts of physical science, little attention being given to the theories. This plan will doubtless lead to good results; but it is singular to note how much the theoretical considerations assist in co-ordinating the facts in physical science. It even appears that in the past, on account of defects in theory, most careful and acute observers have sometimes been obtuse in recognizing what the facts really were. The book covers heat, sound, light, magnetism, and electricity, and is to be commended to American teachers.

Heat as a Form of Energy. By ROBERT H. THURSTON, Boston and New York, Houghton, Mifflin, & Co. 12°. \$1.25.

ONE of the influences which for the past hundred years has been helping along civilization has been that exerted by the employment of heat to do some of the world's rough work. As long as man used only wind-power or water-power to do his sawing or grinding for him, the question of energy—of capacity for doing work—could hardly be a very complicated one. That the motion of the wind-mill must be taken from the motion of the wind might be suspected, and so with the motion of the water-wheel; but when Watt and others had hitched a fire so as to turn a wheel, it began to dawn on philosophers that there was something in this phenomenon that called for explanation. It was soon found by Rumford and his followers that the capacity of heat for doing work was limited; i.e., that there is a mechanical equivalent of heat. But it was reserved for the students of the latter half of this century to show what are the essentials for the conversion of heat into work, and wherein it was possible to improve the steam-engine so as to prevent, as far as may be, the losses which have taken place in the past.

All this history of the development of the theory of the conversion of heat into work is traced in Thurston's book now before us.

Our author goes further, and tells us in plain language the nature of that newer form of heat engine, the gas-engine, which is now attracting so much attention, and shows us what the advantages and disadvantages of this machine are.

What the future may have in store our author does not venture to predict, but he draws attention to the evidence we have of the direct conversion in nature of oxidation processes into electricity, which processes may be imitated by man in due time, with the result of a more economic production of electricity than is now possible. When this shall be, it can readily be understood that electric prime-motors would be a possibility.

Our readers will know that Professor Thurston is the distinguished head of Sibley College of Cornell University, — a college which is in the very front rank of the schools of mechanical engineering, and will deem his clear exposition of the important subject of "Heat as a Form of Energy" as of especial interest in these days when the engines of the ocean greyhounds are so frequently astounding the world with their performances.

AMONG THE PUBLISHERS.

IN the August number of the *Jenness-Miller Magazine*, the physical culture article leads, as usual, in interest.

— John Wiley & Sons announce as in active preparation for immediate publication, "Practical Seamanship," by John Todd and W. B. Whall; "Wrinkles in Practical Navigation," revised and enlarged edition, by Capt. Lecky; and in the Ruskin Library "Seven Lamps of Architecture" (1 volume) and "Praeterita" (3 volumes).

— Mrs. Lyman Abbott, wife of the successor to Henry Ward Beecher as pastor of Plymouth Church, is to become one of the editors of *The Ladies' Home Journal* on Sept. 1 next. An English edition of this journal is to be brought out in London on a scale never before attempted by an American magazine; and Mr. Cyrus H. K. Curtis, the proprietor, and Mr. Edward W. Bok, the editor, sailed for Europe week before last to perfect arrangements.

— On Nassau Street in this city is an establishment devoted exclusively to the publication and sale of maps, charts, atlases, guide-books, globes, etc. The business was begun in a small way a few years ago, and the large dimensions it has assumed speaks well for the rapid and steady increase of public interest in geographical matters, as well as for the energy and enterprise of the proprietor. Maps and atlases have long filled an important place in the trade of many of our publishers and booksellers, but an extensive business based exclusively on cartography is a novelty on this side of the Atlantic.

— The Baker & Taylor Company have just issued "Talks with Ralph Waldo Emerson," by Charles J. Woodbury, who had exceptional opportunities for access to and intercourse with Mr. Emerson. The book is at once an epitome of his philosophy and a commentary upon the time and society in which he lived. It is largely addressed to the youth of our country who aspire to that true cultivation which was never better exemplified than in Emerson's thought, work, and life. A hitherto unpublished portrait of the Concord philosopher is printed with the volume.

— D. C. Heath & Co. (Boston) will issue shortly Anatole France's "Abeille," edited by Charles P. Lebon of the English High School, Boston; De Vigny's "Laurette, ou Le Cachet Rouge," edited by Professor Alcée Fortier of Tulane University, New Orleans; and "Selections for German Composition," with notes and vocabulary, by Professor Charles Harris of Oberlin. These selections are progressive, and each complete in itself. The book is compiled with the belief that much practice in translating easy English is better than slow and laborious work on difficult English.

— Robert Clarke & Co., Cincinnati, have in preparation an important contribution to American archæology, entitled "The Antiquities of Tennessee," by Gates P. Thruston. The author describes the recent excavations among the mounds and stone grave cemeteries of Tennessee, which have brought to light a large number of new objects, illustrating the arts and industries of the mound-builders of the Mississippi valley. Many of them have been discovered by the author, or under his supervision. More than five hundred of these objects will be illustrated in the engravings in this work, a number of them unique and of great interest.

— The July number of the *Quarterly Review*, issued in this country in the original English form, under authority of the English publishers, by the Leonard Scott Publication Company, New York, contains its usual quota of articles. The most important one, so far as Americans are concerned, is unquestionably that which closes the number, dealing with the government of New York City. This paper, entitled "Twenty Years of Home Rule in New York," treats of the ascendancy of the Irish in the local government of the greatest city of America, and will undoubtedly attract wide attention. The opening paper of the quarterly, on Eton College, tells the history of one of the most ancient educational institutions in the world, and considers more especially its place in English educational history. An article on the Emperor Frederick, based on Gustav Freytag's "Reminiscences," reviews

the more important events in the personal history of the ill-fated prince. The study of the modern French novel, begun in the April number, is concluded in a paper on "Realism and Decadence in French Fiction," dealing with the works of Balzac, de Stendhal, Flaubert, Zola, Daudet, Bourgot, and some of the more recent French literary critics. An important paper on "Shakespeare's Ghosts, Witches, and Fairies" discusses the belief of the poet in the realities of these beings. An article on "The Acropolis of Athens," accompanied with a map, reviews the more important of recent archæological discoveries at this famous place and the light they throw upon the ancient Athenian civilization. An article on "Penny Fiction," which will attract great attention, considers the present state of the "penny-dreadful," and presents a characteristic picture of English literary life below stairs. Most of the publications noticed in this essay are almost unknown in America, but they possess a decided importance of their own from their wide circulation and almost total want of literary merit. The personal and political history of Sir Robert Walpole is discussed in an important study of the great statesman and his times. An article on "Western China: its Products and Trade," opens up the question of intercourse with the interior of China; and a paper on "Mesmerism and Hypnotism" brings the number to a conclusion.

— The *Edinburgh Review* for July, issued in this country in the original English form, under authority of the English publishers, by the Leonard Scott Publication Company, New York, opens with a paper on "The Earls of Haddington." The founder of this family was the most influential man in Scotland in his day; and the story of his life, and the progress of his family, are concerned with many important events in Scottish history. The recent promulgation, by the Mikado of Japan, of a monarchical constitution, serves as a text for a highly picturesque account of progress in Japan, wherein the remarkable and rapid civilization of this Oriental power is concisely depicted. The comparisons between old and new Japan in this paper will be found particularly interesting. An article on "The Life and Works of Lavoisier" gathers together many scattered fragments concerning the personal history of the celebrated French scientist, whose murder in the Revolution was one of the darkest plots upon that dark time. An essay on "The Origin of Alphabets" traces the beginnings and early progress of the most useful invention of mankind. It briefly considers the various theories that have been put forth to explain its origin, and traces the linguistic, political, geographical, commercial, and religious causes that have produced it. An article on "Montchrestien, the First French Economist," tells the story of the life and works of a man who preceded Adam Smith in the study of social science. The history of this scholar has been almost lost in obscurity, and the present is the most available account in English of the nature of his studies. Another article in social science deals with religious persecution in Russia, treating the subject historically from the earliest times to the present. It throws much light on the present status of Protestants and Catholics in the Russian Empire. A study of birds in great Britain reviews the natural history of birds native to the British Isles. Their relations to man, and general place in the economy of nature, are carefully considered. The biographical papers in the number are increased by articles on Marie Bashkirtseff, and Charles, Prince de Ligne, the latter one of the most picturesque figures in the social life of Europe in the eighteenth century. A paper on "The Campaign in the Sudan" deals with the late war in that region, and devotes considerable space to Gen. Gordon's part in it. The number concludes with the usual political article entitled "The House of Commons Foiled," dealing with the paucity of results accomplished by the present session of Parliament.

— "For the sake of the American author who is now robbed, for the sake of the foreign author who is now plundered, for the sake of that vast body of people who read books in the United States, and upon whom we now force all the worst and cheapest stuff that the presses of the world pour forth, a bill for international copyright ought to be passed. Most of all, it ought to be passed for the sake of the country's honor and good name." So writes Henry Cabot Lodge on "International Copyright" in the

August *Atlantic*. "The Use and Limits of Academic Culture," a paper by Professor N. S. Shaler, which shows the manner in which Professor Shaler believes the college could be brought into closer touch with the aims of the ordinary student, namely, the gaining of a living, is a noticeable paper of the number. Dr. Holmes ends his instalment of "Over the Teacups" with some verses which will have great vogue, entitled "The Broomstick Train, or the Return of the Witches." The Salem witches, he tells us, impatient at their long imprisonment, petitioned to be released; but, when the Evil One allowed them their liberty, they played such mad pranks, that he called them together, and, for punishment, made them pull the electric cars.

"Since then on many a car you'll see
A broomstick plain as plain can be;

As for the hag, you can't see her;
But, hark! you can hear her black cat's purr,
And now and then, as a train goes by,
You may catch a gleam from her wicked eye."

—A portrait of the African explorer Capt. Gaetano Casati forms the frontispiece of the May number of the *Bulletin of the Italian Geographical Society*. Casati reached Cairo early in May, and letters in the *Bulletin* deal with his journey to the coast with Emin and Stanley. An itinerary of his nine years of travel, says *Nature*, shows that he left Suakin for Berber and Khartoum in January, 1880. In July of the same year he started in a sailing-boat down the White Nile to Mishra-el-Rek, and thence on foot to Wau, where he met with Gessi at the end of September. He then threaded his way southwards among the feeders of the Bar-el-Gazal to the Kongo basin, and for some time made Tangasi, on the Welle or Makua branch, a centre for exploration. Close by, at Mboro, in June, 1881, he met with Dr. Junker. Finally he made his way to Ladò, on the main stream of the White Nile; and there, at the end of March, 1883, he met Emin Pacha for the first time. Thence he walked up the left bank to Wadelai, and con-

tinued the voyage up the Albert Nyanza by steamboat. It was not until April 28, 1888, that the meeting between Emin Bey, Casati, and Stanley took place on the plateau above Kavalli to the south-west of the lake. The journey down the Semliki valley, the exploration of Lake Albert Edward, and the return to Zanzibar, are recent history. The remaining papers of the number deal mainly with South America. The most interesting of these is that of Count Orsi di Broglia di Mombello on the sculpture of the primitive inhabitants of the Upper Orinoco. Many carvings on the stones of tombs have been discovered among the villages of this district: the sculpture is rough and fantastic, but evidently aims at reproducing certain natural objects. Thus, at the Grotto of Caicara, near the right bank of the Orinoco, many rocks carved in the primitive manner of the slate sketches of school-days, evidently exhibit an attempt to figure a tiger that is very common in this district. In neighboring caves were found mummies closely resembling Egyptian ones: this the author regards as further evidence of the common origin of the two races, previously suggested by the striking similarity in shape of the skulls of the South American Indians and those found in the tombs of Egypt.

—The August *Magazine of American History* is filled with a pleasing variety of papers. The opening illustrated paper, "Historic Houses and Revolutionary Letters," by Mr. Robert Ludlow Fowler, contains extracts from hitherto unpublished letters and documents relating to stormy scenes in the most exciting period of our country's annals, with a bright thread of family history—of the ancient Ellisons of colonial New York—running through the animated sketch. The second article, "Glimpses of Log-Cabin Life in Early Ohio," from the pen of Emanuel Spencer, is realistic and picturesque, bringing the log-cabin home to us in earnest, with all its limitations and ambitions. Following this, Clement Ferguson writes of the historic associations of "The Blue and Beautiful Narragansett;" Richard Selden Harvey recites "The True Story of an Appointment;" the editor contributes an epitome of the career of Major-Gen. Ebenezer Stevens, the subject of the

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frontispiece; and Dr. Prosper Bender discusses "The French Canadian Peasantry." The "Prospectus of the First American Edition of Shakespeare," a curious antique treasure, appears in minor topics, and "Sixty Waymarks in the World's Progress" furnishes a list worthy of careful preservation.

— Messrs. Ginn & Co. announce to be published in August or September Shelley's "Defense of Poetry," edited by Albert S. Cook, professor in Yale University. Shelley's "Defense" may be regarded as a companion-piece to that of Sidney. Both are the productions of poets who are also distinguished for their prose; of poets essentially lyrical, whose highest praise is given to the epic and the drama; and in both a substantially identical philosophy is set forth with fervid eloquence. In their diction, however, the one is of the sixteenth century, and the other of the nineteenth. For this reason a comparison of the two is of interest to a student of historical English style. But, apart from this, the intrinsic merits of Shelley's essay must ever recommend it to the lover of poetry and of beautiful English. The truth which he perceives and expounds is one which peculiarly needs enforcement at the present day, and it is nowhere presented in a more concise or attractive form. This edition is provided with all needful helps, and is the only one now current of the "Defense" printed by itself, apart from other prose works of Shelley.

— Messrs. Macmillan will issue early next month a reprint from the collected works of Edward Fitzgerald (1889) of his famous version of the Rubaiyat of Omar Khayyam, which is practically unobtainable, except in those three volumes. The author, as is well known, never put his own name on the titlepage of any of the four editions which appeared during his lifetime, and the show of anonymity is still preserved. In accordance with their admirable custom, which other publishers would do well to follow, Messrs. Macmillan have given on the verso of the titlepage a brief bibliography. The same firm will also publish immediately the first

volume of Professor Alfred Marshall's long-expected treatise entitled "Principles of Economics." It is an attempt to present a modern version of old doctrines with the aid of the new work, and with reference to the new problems of the age.

— *Babyhood* for August cautions parents against allowing children to hear too much about "mad" dogs, since hydrophobia is so rare a disease that most physicians never, in fact, see a case of it; while lyssophobia (i.e., dread of hydrophobia), a purely nervous affection, may and sometimes does prove fatal. This number of the magazine contains also a few hints as to water sports for children, and an illustrated description of the most approved methods of resuscitation from drowning. There is an article upon "Hives," and one upon "Signs of Disease in Early Life," each by an eminent physician. Various questions of diet and clothing, pertinent to the season, are discussed, and the interesting series "Kindergarten on the Farm" is continued.

— The August number of *The Forum* will contain a remarkable essay, by Prince P. Krapotkin, on "The Possibilities of Agriculture." He has made a thorough investigation of the fabulous results of the scientific cultivation of land in the most densely populated portions of Europe, and he shows the ease with which the number of acres now cultivated in the civilized parts of the world can be made to yield sustenance for many times the number of people now alive. Scientific and intensive agriculture in the United States, for instance, can be made to sustain in plenty, and with much greater cheapness than now, a population at least ten times as dense. The writer shows conclusively why it is that such slow progress is made in these revolutionary improvements in agriculture, but he predicts with confidence that we are on the eve of the reign of plenty. He proposes that a hundred acres be cultivated in this way as a part of the exposition at Chicago, in order to demonstrate the possibilities of multiplying many times the products of the American farmer.

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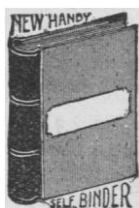
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